Chair for Computation in Engineering
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Software Lab:

Modeling: ★★☆☆☆
Mathematics: ★★★★★
Programming: ★★★★☆

The adjoint method for localizing soil perturbations

Setting

The interior of the earth is full of precious resources like oil reservoirs. The person who finds them first will probably make a fortune selling them. In this SoftwareLab you try to find an oil reservoir in the soil that is not marked on any map. But acoustic measurements have been made which may indicate where you need to dig in order to get rich.

Figure 1: Simulation of compression waves; the wave front is reflected at a cavity and at the domain boundary

However, for making use of the measurements you'll need to apply numerical methods and understand concepts like Time Reversal and the adjoint method to actually find the oil.
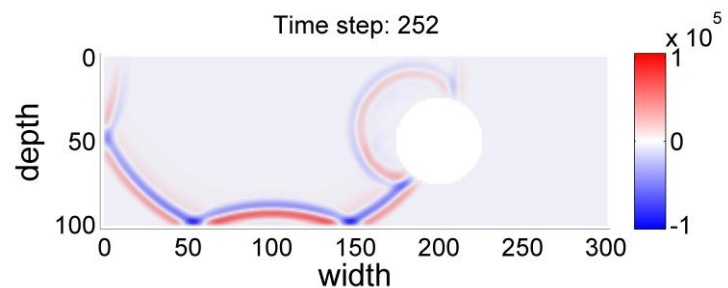
Task

Find the oil, by

- Understanding the governing equations of acoustics
- Implementing different finite-difference schemes (9 point stencil in 2D, 27 point stencil in 3D) to solve the wave equation in MATLAB
- Understanding and implementing *Time Reversal*
- Using the *continuous adjoint state method* to locate the model perturbation

Supervisors

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References

[1] M. Fink, Time Reversed Acoustics, *Sci.Am. 281 (5)*, pp. 91-97, 1999.

[2] A. Fichtner, H.-P. Bunge, H. Igel, The adjoint method in seismology, *Physics of the earth and planetary interiors 157*, pp. 86-104, 2006.